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Abstract

The invention relates to a method and a sensor (15, 9, 14) for improved mass flow measurement. In known thermal mass flow sensors, a gas flow (7) is heated with a heating element (4) and the mass flow is determined from the temperature difference between two thermoelements (5, 6). According to the invention, at least one material-specific parameter is measured in order to characterize the heat transition behavior of the gas (8) and is used to correct the mass flow measurement. Said material-specific parameter is preferably a heat conductivity kappa , a heat capacity c, a product of heat capacity and density $c^* \rho$ and/or a diffusivity α . The special sensor (9) that is provided for measuring kappa and/or c or $c^* \rho$ is structured similarly to the mass flow sensor (15) but is exposed to a current-free part (8a) of the medium (8). The advantages of the invention are e.g., better precision, even for unknown or variable thermal properties of the gas (8).

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The invention solves the problem to provide an improved method and improved device for measuring mass flow. This problem is solved according to the invention by the features of the independent claims.

According to the invention, in a mass flow measurement of the mentioned type at least one substance-specific parameter of characterizing the heat transition behavior of the fluid is measured for correcting a measured mass flow signal. In this manner, a mass flow sensor with very high measurement accuracy and flexible applicability is created. In particular, the mass flow of arbitrary gases can be measured reliably and independently of the thermal properties of the gas.

In a preferred embodiment, the substance specific parameters are a thermal conductivity κ and/or a heat capacity c and/or a product of heat capacity and density $c^*\rho$ and/or a diffusivity α.

In another embodiment, the type or composition of the fluid is determined from the substance-specific parameter. From this, further, e.g. tabulated, parameters of this fluid can be derived for a mass flow correction and in particular for the determination of a heat value.

In a further embodiment, in addition a state variable of the fluid, e.g. a pressure and/or a temperature, is measured in by means of this a substance-specific parameter is corrected.

An important embodiment concerns the measurement of the thermal conductivity κ and/or the thermal capacity c or $c^*\rho$ by means of a second sensor, which is built similar as the mass flow sensor, but which is arranged in a substantially flow-free region of the fluid.

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In a preferred embodiment according to fig. 2 the mass flow sensor 15 is to comprise a second sensor 9 for measuring the thermal conductivity κ and/or the heat capacity c

or c*ρ. In particular, the mass flow sensor 15, the second sensor 9 and the measuring means 14 are arranged on a single chip 1. Chip 1 is typically built on the basis of silicon or possibly gallium arsenide. As shown in Fig. 2, chip 1 can be built such that, in a mounted or inserted state, mass flow sensor 15 is exposed to flow 7 of fluid 8 and sensor 9 is exposed to the substantially stationary fluid 8a in blind hole 13.

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the mass flow sensor according to the invention is especially suited for mass flow measurements in gases. In particular, it can be used for gas meters in fuel supply plants. In this case, it is in particular possible to measure a substance specific parameter of the gas 8, to characterize the type or composition of the gas 8, to determine the corresponding specific heat value from data known before, and to calculate, together with the mass flow measurement, the total heat value of the gas 8. Other applications relate to embodiments of the mass flow sensor 15 for installation in devices for industrial process gases, in climatization apparatus, in medical apparatus or in sports and recreational apparatus.